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| APPLICATION NO.                  | FILING DATE | FIRST NAMED INVENTOR  | ATTORNEY DOCKET NO.    | CONFIRMATION NO. |
|----------------------------------|-------------|-----------------------|------------------------|------------------|
| 10/657,894                       | 09/09/2003  | Hieronymus Andriessen | 224088                 | 2642             |
| 23460                            | 7590        | 07/03/2007            | EXAMINER               |                  |
| LEYDIG VOIT & MAYER, LTD         |             |                       | BARTON, JEFFREY THOMAS |                  |
| TWO PRUDENTIAL PLAZA, SUITE 4900 |             |                       | ART UNIT               |                  |
| 180 NORTH STETSON AVENUE         |             |                       | PAPER NUMBER           |                  |
| CHICAGO, IL 60601-6731           |             |                       | 1753                   |                  |
| MAIL DATE                        |             | DELIVERY MODE         |                        |                  |
| 07/03/2007                       |             | PAPER                 |                        |                  |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| <b>Office Action Summary</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|------------------------------|------------------------|---------------------|--|
|                              | 10/657,894             | ANDRIESSEN ET AL.   |  |
| Examiner                     | <b>Art Unit</b>        |                     |  |
| Jeffrey T. Barton            | 1753                   |                     |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

1)  Responsive to communication(s) filed on 01 May 2007.

2a)  This action is **FINAL**.                    2b)  This action is non-final.

3)  Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

4)  Claim(s) 1-14 is/are pending in the application.  
4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
5)  Claim(s) \_\_\_\_\_ is/are allowed.  
6)  Claim(s) 1-14 is/are rejected.  
7)  Claim(s) \_\_\_\_\_ is/are objected to.  
8)  Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

9)  The specification is objected to by the Examiner.

10)  The drawing(s) filed on \_\_\_\_\_ is/are: a)  accepted or b)  objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)  The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)  Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a)  All    b)  Some \* c)  None of:  
1.  Certified copies of the priority documents have been received.  
2.  Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3.  Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1)  Notice of References Cited (PTO-892) 4)  Interview Summary (PTO-413)  
2)  Notice of Draftsperson's Patent Drawing Review (PTO-948) Paper No(s)/Mail Date. \_\_\_\_.  
3)  Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date . 5)  Notice of Informal Patent Application  
6)  Other: .

**DETAILED ACTION**

***Response to Amendment***

1. The remarks filed on 1 May 2007 do not place the application in condition for allowance.

***Status of Rejections Pending Since the Office Action of 1 February 2007***

2. All rejections are maintained.

***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Graetzel et al (EP 1 176 646 A1) in view of Van der Auweraer et al (J. Phys. Chem. 1993, 97, 8808-8811). Supporting evidence is provided by Thelakkat. (Macromol. Mater. Eng. 2002, 287, 442-461)

Regarding claims 1 and 8, Graetzel et al disclose a photovoltaic device (Figures 1 and 2) comprising an n-type semiconductor with a bandgap over 2.9 eV (Titanium dioxide particles 6; Page 3, line 58 - Page 4, line 1), and an amorphous reversibly oxidizable hole-transporting organic material. (Page 2, lines 39-44)

Regarding claims 3 and 10, Graetzel et al disclose using several of these semiconductors. (Page 2, lines 36-38)

Regarding claims 4-6 and 11-13, Graetzel et al disclose quantum dot spectral sensitizers (Figure 2, q-dots 7), which are disclosed as nanoparticles of metal chalcogenides, such as PbS or HgSe/CdSe. (Page 3, lines 6-8 and 19-22)

Regarding claims 7 and 14, Graetzel et al disclose methods of making their photovoltaic cells, comprising providing a support with a conductive layer as an electrode (Tin oxide-coated glass; Page 4, line 5), coating the conductive layer on the support with the n-type semiconductor (Page 4, lines 5-8), coating the n-type semiconductor with a solution of the hole transport material that is subsequently dried (Page 4, lines 14-17), and applying a conductive layer to the hole transport material layer to provide a second electrode. (Page 4, lines 18-19)

Graetzel et al does not disclose hole-transport compounds as claimed in instant claims 1, 2, 7, 8, 9, and 14.

Van der Auweraer et al teach the hole transport abilities of amorphous layers of 5'-[4-[Bis-(4-ethylphenyl)amino]phenyl]-N,N,N',N'-tetrakis-(4-ethylphenyl)-1,1':3',1"-terphenyl-4',4"-diamine, which corresponds to the structure given in claims 1, 7, 8, and 14, and the first listed compound in claims 2 and 9. This compound is shown to have comparable or superior hole mobility to other known hole transport materials. (Table I)

It would have been obvious to one having ordinary skill in the art to modify the devices and methods of Graetzel et al by replacing their hole transport material with the compound taught by Van der Auweraer et al, because Van de Auweraer et al teach its comparable or superior hole mobility to other known hole transport materials. The selection of a known material based on its suitability for its intended use supports a

prima facie obviousness determination. See *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Regarding the limitation to the compound being in "cationic form" in claims 1-7, the presence of a hole in this hole transport material inherently imparts a positive charge to the molecule, since the hole is the absence of an electron. Van der Auweraer speaks of a "one electron oxidation-reduction process" (Introduction, 1<sup>st</sup> paragraph) associated with hole or electron transport, and a more thorough description of hole transport in triarylamine compounds is given by Thelakkat. (Pages 443-444, "Triarylamine as Functional Moiety" section) This section of Thelakkat describes the triarylamine unit's "ability to transport positive charge centers via the radical cation species". Since hole transport in triarylamine compounds is clearly associated with a cyclic oxidation/reduction process involving a cationic radical species, it is the examiner's position that the cationic form of the hole transport material taught by Van der Auweraer will inherently be present in the device taught by this combination.

7. Claims 1, 3-8, and 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Graetzel et al (EP 1 176 646 A1) in view of Shirota. (J. Mater. Chem., 2000, 10, 1-25) Supporting evidence is provided by Thelakkat. (Macromol. Mater. Eng. 2002, 287, 442-461)

Regarding claims 1 and 8, Graetzel et al disclose a photovoltaic device (Figures 1 and 2) comprising an n-type semiconductor with a bandgap over 2.9 eV (Titanium

dioxide particles 6; Page 3, line 58 - Page 4, line 1), and an amorphous reversibly oxidizable hole-transporting organic material. (Page 2, lines 39-44)

Regarding claims 3 and 10, Graetzel et al disclose using several of these semiconductors. (Page 2, lines 36-38)

Regarding claims 4-6 and 11-13, Graetzel et al disclose quantum dot spectral sensitizers (Figure 2, q-dots 7), which are disclosed as nanoparticles of metal chalcogenides, such as PbS or HgSe/CdSe. (Page 3, lines 6-8 and 19-22)

Regarding claims 7 and 14, Graetzel et al disclose methods of making their photovoltaic cells, comprising providing a support with a conductive layer as an electrode (Tin oxide-coated glass; Page 4, line 5), coating the conductive layer on the support with the n-type semiconductor (Page 4, lines 5-8), coating the n-type semiconductor with a solution of the hole transport material that is subsequently dried (Page 4, lines 14-17), and applying a conductive layer to the hole transport material layer to provide a second electrode. (Page 4, lines 18-19)

Graetzel et al does not disclose hole-transport compounds as claimed in instant claims 1, 7, 8, and 14.

Shirota teaches the hole transport abilities of amorphous TDAPB and *o*-, *m*-, and *p*-MTDAPB, which correspond to the structure given in claims 1, 7, 8, and 14. (Structures on page 4, partial mobility data in Table 3) This compound is shown to have comparable hole mobility to other known hole transport materials. (Table 3) In addition,

Shirota teaches the usefulness of these organic hole transport materials in photovoltaic cells, including photoelectrochemical cells, such as those taught by Graetzel.

(Introduction, Organic photovoltaic devices sections)

It would have been obvious to one having ordinary skill in the art to modify the devices and methods of Graetzel et al by replacing their hole transport material with TDAPB, *o*-, *m*-, or *p*-MTDAPB as taught by Shirota, because Shirota teach its effectiveness in hole transport and suggests the usefulness of this class of compounds in providing hole transport in photoelectrochemical cells. (Introduction, Organic photovoltaic devices sections) The selection of a known material based on its suitability for its intended use supports a *prima facie* obviousness determination. See *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Regarding the limitation to the compound being in “cationic form” in claims 1 and 3-7, the presence of a hole in this hole transport material inherently imparts a positive charge to the molecule, since the hole is the absence of an electron. A description of hole transport in triarylamine compounds is given by Thelakkat. (Pages 443-444, “Triarylamine as Functional Moiety” section) This section of Thelakkat describes the triarylamine unit’s “ability to transport positive charge centers via the radical cation species”. Since hole transport in triarylamine compounds is associated with a cyclic oxidation/reduction process involving a cationic radical species, it is the examiner’s position that the cationic form of the hole transport material taught by Shirota will inherently be present in the device taught by this combination.

***Response to Arguments***

8. Applicant's arguments filed 1 May 2007 have been fully considered but they are not persuasive.

Applicant argues that the Office Action discounts the cationic form limitations of claims 1-7. This is not true. The Examiner's position is that the combinations made in the rejections will inherently include the claimed hole transport compounds in cationic form.

Applicant argues that the hole-transport compounds of Van der Auweraer are non-ionized compounds, which would not be inherently ionic. The Examiner agrees. However, in the process of hole conduction, holes must inherently be present within molecules of the compound. Since the hole is the absence of an electron from a material, this must inherently impart a positive charge to the molecule. Applicant's claims are not limited to a material that is in a stable cationic form, nor does it require that all molecules of the material be in a cationic form. Claim 1 merely requires a cell containing the material in cationic form. The presence of a hole in a molecule of the hole transport material taught by Van der Auweraer will inherently provide that molecule with a cationic charge. Therefore, in operation, the cells taught by the combinations above will meet the claim limitations.

Applicant's arguments concerning the inoperability of the hole transport material of Van der Auweraer if it were cationic are not persuasive because the rejection does

not require modification of the material to a permanent cationic form as implied in the remarks.

Applicant's description of the examples from the specification to further describe the cationic form of the instant material are not persuasive, because Applicant's claims are not limited to a cationic form as described in these examples. Claim 1 simply recites that "said 1,3,5-tris-aminophenyl-benzene compound is in cationic form". In operation, the presence of a hole in the hole transport material of the combinations meet this limitation.

Applicant's arguments against the combination of Graetzel et al with Van der Auweraer et al are not persuasive because Van de Auweraer et al teach the comparable or superior hole mobility of their material relative to other known hole transport materials. The selection of a known material based on its suitability for its intended use supports a *prima facie* obviousness determination. See *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Furthermore, Graetzel et al clearly envision selection of known hole transport materials, including reversibly oxidizable organic compounds, such as that taught by Van der Auweraer et al. (Graetzel et al, paragraph 0012) The motivation for the combination is clear.

Applicant's similar arguments against the combination of Graetzel et al with Shirota et al are similarly not persuasive. Just as in the previous combination, the process of hole transport in the hole transport material of Shirota et al will inherently require molecules of the hole transport material to take a positive charge. The motivation for combination of the references is again quite clear, with the suggestion of

reversibly oxidizable organic hole transport materials by Graetzel et al (Paragraph 0012) and the direct suggestion of Shirota et al that their hole transport materials are suitable for use in photoelectrochemical cells. (Introduction, Organic photovoltaic devices sections)

### ***Conclusion***

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Jeffrey T. Barton whose telephone number is (571) 272-1307. The examiner can normally be reached on M-F 9:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JTB  
29 June 2007

  
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